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TABLE G—EQUATIONS OF LINES OF SECULAR TREND FOR VARIOUS SERIES

SERIES	EQUATIONS *	UNITS
1. New York Clearings.....	$y = + .30x + 6.06$	Billion dollars
2. Production of Pig Iron.....	$y = + .95x + 1461$	Thousand gross tons
3. Outside Clearings.....	$y = + .29x + 3.46$	Billion dollars
4. Bradstreet's Prices.....	$y = + .11x + 7.94$	One dollar
5. Imports.....	$y = + .70x + 8.05$	Ten million dollars
6. Building Permits.....	$y = + .99x + 35.2$	Million dollars
7. Railroad Gross Earnings.....	$y = + 2.95x + 40.8$	Million dollars
8. Shares Traded.....	$y = - .52x + 18.22$	Million shares
9. Unfilled Orders U. S. S. C.....	$y = + .22x + 3.86 \dagger$	Million tons
10. Tonnage Entered.....	$y = + .70x + 1921 \ddagger$	Thousand net tons
11. Business Failures (Bradstreet).....	$y = + .54x + 727$	One failure
12. Rate on 10 Railroad Bonds.....	$y = + .05x + 3.85$	One per cent
13. Rate on 4-6 Months Paper.....	$y = - .10x + 5.98 \S$	One per cent
14. Rate on 60-90 Day Paper.....	$y = - .09x + 5.26$	One per cent
15. Rate on Call Loans.....	Not found	One per cent

* Abscissas (x) measured in years from 1903.

† Abscissas (x) measured in years from 1908.

‡ Abscissas (x) measured in years from 1900.

§ The equation of the line fitted for the period 1890-1915 is $y = - .05x + 6.29$, where the abscissas (x) are measured in years from 1890.

trend it was thought undesirable to include the years of depression without also including offsetting years of activity. The secular trend of wholesale prices was determined for the period ending in 1914, because of the unprecedented disturbance of prices after that year.

In estimating the secular trend for the period since 1916 (or, in the case of prices, since 1914) we have simply extended the straight lines determined from the data of the preceding period, 1903-16. This has been done because the upheaval during the years 1917, 1918 is not thought to be in the nature of a change of trend. It is possible, indeed, that the secular trend in the decade beginning with 1919 may be more strongly upward than it was in the period 1903-16, but more evidence is needed before such a conclusion can satisfactorily be maintained. Indeed evidence may be offered indicating that the trend of the immediate future will be less strongly upward than it has been. In any case, it is improbable that a change of trend, if a change has occurred, would be as strongly upward as would be the trend obtained by using straight lines determined from data including items for 1917 and 1918.

4. SUMMARY OF RESULTS FOR EACH SERIES.

The source and nature of the series presented graphically in Charts 1 to 15 are given in the following summary. The numbers of the series (in parenthesis) are the same as those of the charts and frequency tables constructed from such series. Tables of the original series, the moving averages, the month-to-month link relatives, and the percentage deviations of the original items from the corresponding ordinates of secular trend corrected for seasonal variation are given in connection with Charts 1 to 15. The percentage deviations, just named, are presented graphically in Charts 101 to 114, the units used being the respective standard deviations; the digits, in the units and tens places of the chart numbers, correspond to the number of the series upon

which they are based. (For instance, Chart 1, Table 1, Chart 101 all pertain to Series 1.) The equations of the lines of secular trend and the standard deviations are given in Tables F and G respectively. The indices of seasonal variation are given in the frequency tables of link relatives; graphs of the indices are presented as inserts of Charts 1 to 15.

(1) MONTHLY BANK CLEARINGS OF NEW YORK CITY

SOURCE AND NATURE OF DATA. In the first or second issue each month of the *Commercial and Financial Chronicle*, monthly items of bank clearings for New York City appear under the caption "Bank Clearings at Leading Cities." This table gives a comparison of the month just completed with the corresponding month for three or more years preceding. Our figures have been secured from this source; but, when revised figures appeared, the current item in each issue has been replaced by the item published a year later.

The tables presented by the *Chronicle* give both the absolute figures and the relative per cent of increase or decrease of the figures for the months of the current year over those of the preceding year; but only the absolute figures have been utilized. It is possible that the inauguration of the clearing system of the Federal Reserve Board has made New York clearings of little value as an index of business conditions. This system appears to have affected New York clearings much more than outside clearings. The effect on the latter is not evident. New York clearings reached a maximum in the autumn of 1916; outside clearings are now, in the autumn of 1918, establishing new high records.

SECULAR TREND. The linear trend, 1903-16 (Chart 1), has a uniform annual increment of \$295,000,000. The average of the monthly items is \$7,980,000,000. The fit of the line to the data is close throughout, except during the war period, 1914-18.

SEASONAL VARIATION. The grouping of the link relatives (Table 1) indicates the presence of seasonal variation. The features of the movement are the mid-summer drop from July to September (indices 97 to 90), the autumn and winter rise from October to January (indices 109 to 115) and the drop to the yearly average from February to May or June.

The link relatives (Chart 1) fluctuate widely, covering a range from 56 in August 1914, and 67 in November 1907 to 140 in October 1904, 136 in October 1907, and 136 in October 1912. Other extreme items occur, usually in years of crises or other marked disturbances. The items of the series fluctuate violently.¹

CYCLES. The curve of twelve months moving averages shows a distinct wave movement for the period 1903-10, but the extended trough 1910-15 is noticeable, as are also the high points reached during the years 1915-18. The maximum divergence from the linear trend during the pre-war period is about 30 per cent of the corresponding ordinate of secular trend. During the early part of 1917, a maximum divergence of about 50 per cent is reached.

The cycles (Chart 101) vary between $+2.5\sigma$ and -2.5σ except in the years 1916-17, when $+3.0\sigma$ is reached. The irregular fluctuations are marked. ($\sigma = 20.3$)

(2) MONTHLY TONNAGE OF PIG IRON PRODUCED IN THE UNITED STATES

SOURCE AND NATURE OF DATA. The monthly items of this series are given in preliminary form in the second issue each month of the *Iron Age* under the caption "Pig Iron: Monthly Statement." The revised figures utilized have been taken from issues of two months or more following the date of the item.

Except for the negligible output of charcoal furnaces, these data are complete, for they cover all coke and anthracite furnaces in blast. The owners of furnaces make monthly report to the *Iron Age* on forms furnished by that publication. From figures thus secured, monthly totals and daily averages are printed, the former being utilized here. The editor of the *Iron Age* states that the method of collection and compilation has been uniform since 1885.

SECULAR TREND. The linear trend, 1903-16 (Chart 2), has a uniform annual increment of 95,200 tons. The average of the monthly items is 2,079,000 tons. The fit of the line to the data is close throughout, except during the few months immediately following the outbreak of the European war.

SEASONAL VARIATION. The grouping of the link relatives of Table 2 reveals seasonal variation. The greatest activity of the year is in March, April, May, and October (indices 103 to 106); the duller period is in June, July, and August (indices 97 to 98).

The link relatives (Chart 2) varied from a minimum of 67 in December 1907 to a maximum of 131 in February 1904. Exceptionally low relatives occurred in

January 1908 (85), June 1904 (84), July 1904 (86), November 1903 (73), and November 1907 (78). Exceptionally high relatives occurred in April 1904 (107), July 1908 (112), and September 1904 (116).

CYCLES. The curve of twelve months moving averages shows a distinct wave movement, except that during the period 1915-18 there is a long crest with no downward tendency at present visible. The maximum divergence from the linear trend is about 30 per cent of the corresponding ordinate of secular trend for the latter part of 1914.

The cycles (Chart 102) vary between $+1.5\sigma$ and -2.5σ . The irregular fluctuations are comparatively small, although a precipitate drop occurred at the end of 1916. ($\sigma = 19.15$)

(3) MONTHLY BANK CLEARINGS OF THE UNITED STATES OUTSIDE NEW YORK CITY

SOURCE AND NATURE OF DATA. The *Commercial and Financial Chronicle* contains in the first or second number each month a table entitled "Monthly Clearings." This table summarizes clearings outside New York for each month of the year up to the current month, and gives for comparison revised figures for the corresponding months of the preceding year. In this study, the revised figures have been taken.

As with the New York clearings, the *Chronicle* gives both absolute figures and per cent of increase or decrease over corresponding months of the preceding year. The data are reported by mail and telegraph by the managers of clearing houses or copied from local newspapers. The editor of the *Chronicle* states that they cover all clearing houses; so that, as the number of these has increased, the new ones have been included.

One defect of bank clearings as an index of business conditions is that the series is affected by changes in the method of handling checks. The introduction of the Federal Reserve clearing system undoubtedly has interfered with the flow of bank checks passing through the New York and other clearing houses. If banks could be induced to report the total amount of checks drawn on and paid by each, such reports would constitute a good substitute for clearings. Two agencies, the Federal Reserve Board and the Clearing House Section of the American Bankers' Association, have independently undertaken the task of securing reports of total transactions from banks. On August 1, 1918, it was reported that a plan was adopted by the Federal Reserve Board under which "accurate reports offering an index of the volume of banking business at various Clearing House points will be gathered through the Federal Reserve system. Each Clearing House Manager will be asked to report weekly to his district Reserve bank the totals of checks drawn on and paid by each reporting bank, separating those drawn by individuals, firms, corporations, and the government under one head, and those drawn by banks under another. This information is to be furnished by members of the

¹ See also Chart D and discussions in Part I, Section 3.

Clearing House. Reports from all districts will be compiled by the Reserve Board. Present Clearing House returns, it is pointed out, show only the total of checks which actually pass through the Clearing House, and do not include the large volume of checks settled through individual member banks."¹ On July 31, 1918, the Clearing House Section of the American Bankers' Association announced that it "has developed a plan under which total bank transactions may be accumulated almost automatically. These figures are of tremendous value to the individual banks and to the general business public. Twenty-nine cities are now compiling and reporting these figures to the Clearing House Section. They are reported weekly on forms furnished by the Section.

"A statement of the figures will hereafter be given to the press quarterly. The clearings and total bank transactions for the twenty-nine cities now reporting for the second quarter of 1918 are given herewith."² The twenty-nine cities reporting did not include many of the largest cities of the United States. Total bank transactions of reporting cities for the second quarter of 1918 amounted to \$22,897,936,000 and clearings amounted to \$9,833,621,000. Total bank transactions of thirty-one cities for the third quarter of 1918 amounted to \$24,612,522,000 and clearings amounted to \$10,386,635,000. Under date of January 2, 1919 Jerome Thralls, Secretary of the American Bankers' Association, stated that "quite likely the Clearing House Section will abandon the compilation of these figures as soon as the Federal Reserve Board's plan is thoroughly established."

A necessary feature of any series used as an index of business conditions is that past data must be used as a basis of judging current data. It is probably true that bank clearings will afford the necessary background for judging bank transactions.

SECULAR TREND. The linear trend, 1903-16 (Chart 3), has a uniform annual increment of \$292,200,000. The average of the monthly items is \$5,360,000,000. The fit of the line to the data is very close, except during the period 1916-18.

SEASONAL VARIATION. The close grouping of the link relatives (Table 3) indicates seasonal variation. The features of the movement are the drop in August and September (indices 91 and 94), the violent rise in October lasting through January (indices about 108), and the gradual drop to July.

The link relatives (Chart 3) fluctuate from a minimum of 75 in November 1907 to a maximum of 124 in October of three years, 1906, 1907, and 1912. Erratic relatives occur in January 1908 (114), in August 1903 (86), in August 1914 (85), and in other years of recognized disturbance.³

CYCLES. During the pre-war period the curve of twelve months moving averages shows a wave move-

ment of very small amplitude. During the period 1916-18, however, this curve has gradually risen to a point about 60 per cent above the corresponding ordinate of secular trend. Prior to 1915, the largest divergence from the linear trend is about 20 per cent of the ordinate of trend in the latter part of 1914.

The cycles (Chart 103) vary between $+1.5\sigma$ and -3.0σ except during the years 1916-18, when an unprecedented rise took place. For 1917 and 1918 the cycles are not plotted since they range from a minimum of -2.7σ to a maximum of $+9.8\sigma$. The irregular fluctuations are marked. ($\sigma = 8.62$)

(4) BRADSTREET'S MONTHLY INDEX OF COMMODITY PRICES

SOURCE AND NATURE OF DATA. Data used in this series appear each week in *Bradstreet's* as one group of items under the general heading "Measures of Movements." Transcriptions have been made, however, from an issue of every fourth month, where revised comparative figures for three months preceding the current month are given.

The method of computing this index, which measures prices for the preceding months, has been fully described by Wesley C. Mitchell, "The Making and Use of Index Numbers," *Bulletin of the Bureau of Labor Statistics*, No. 173.

SECULAR TREND. The linear trend, 1903-14 (Chart 4), has a uniform annual increment of eleven cents. The average of the monthly items is \$8.56. The fit of the line to the data is extremely close, the series being a very regular one. This statement does not hold, however, for 1915-18, during which period the data have steadily risen to a point about double the ordinate of secular trend.

SEASONAL VARIATION. The grouping of the link relatives (Table C) shows a slight tendency toward seasonal variation, the relatives being somewhat scattered. The indices vary about one per cent from the average of the year. The months May to September are below, and the other months above, the yearly average. Compared with other variations the seasonal variation is not important (Table 4). The seasonal variation has been found to correspond very closely to that found for the indices of prices of the Bureau of Labor Statistics.

The link relatives (Chart 4) vary from minima of 96.3 in January 1914, 97.3 in January 1908, 94.7 in October 1914, and 95.8 in November 1914 to maxima of 105.8 in February 1915, 112.0 in September 1914, 106.3 in November 1916, and 106.8 in December 1916. Unprecedented monthly changes occurred during the period following the declaration of war in July 1914.

CYCLES. The curve of twelve months moving averages shows a distinct and regular wave movement of exceedingly small amplitude. The maximum divergence (prior to 1915) from the linear trend is about 6 per cent of the corresponding ordinate of secular trend. During the years 1915-18 the averages have steadily

¹ *Commercial and Financial Chronicle*, August 10, 1918, p. 554.

² *Ibid.*, p. 551.

³ See also Chart E and discussion in Part I, Section 3.

risen to a point about double the ordinate of secular trend.

The cycles (Chart 104) range from $+2.5\sigma$ to -2.5σ except for the years 1915 to 1918. In 1915 an unprecedented rise took place, reaching a maximum of $+26.9\sigma$ in July 1918. The cycles for 1916 to 1918 are not plotted since the range is from $+4.6\sigma$ to $+26.9\sigma$. The irregular fluctuations are not marked except during the period following the beginning of the Great War in 1914. ($\sigma = 3.68$)

(5) MONTHLY IMPORTS OF MERCHANDISE INTO THE UNITED STATES, VALUES

SOURCE AND NATURE OF DATA. This series was transcribed from the *Monthly Summary of Foreign Commerce of the United States*. Since the figures, as given in the current issues are preliminary and subject to revision, items for any given year have been transcribed either from the December issue of the following year, or as last published. The figures for 1917 and 1918 are only preliminary and subject to revision.

These official governmental statistics presumably cover all imports.

SECULAR TREND. The linear trend, 1903-16 (Chart 5), has a uniform annual increment of \$7,038,000. The average of the monthly items is \$126,240,000. The fit of the line to the data is very close, the greatest divergence being in 1916-18.

SEASONAL VARIATION. The grouping of the link relatives (Table 5) shows a tendency toward seasonal variation, though not as marked as in outside bank clearings. There is a summer slump from May to September (minimum index of 94 in July) and an autumn, winter, and spring rise reaching its maximum in March (index of 111).

The link relatives (Chart 5) are widely scattered in some months, especially in the autumn. Minima occurred in July, 1916 and 1917 (74 and 73); maxima occurred in March, 1915 and 1917 (126 and 136).

CYCLES. The curve of twelve months moving averages shows a small, and at times rather indefinite, wave movement. The prolonged crest for 1916-18 is noticeable. The maximum divergence from the linear trend is about 20 per cent of the corresponding ordinate of secular trend.

The cycles (Chart 105) range from $+2.0\sigma$ to -2.5σ except during the period 1916-18, when $+6.2\sigma$ was reached. The irregular fluctuations are so very marked that they interrupt the cyclical movement. ($\sigma = 11.91$)

(6) MONTHLY VALUES OF BUILDING PERMITS ISSUED FOR TWENTY LEADING CITIES

SOURCE AND NATURE OF DATA. These figures are taken from *Babson's Desk Sheet* dated May 10, 1911, which covers the period 1903-10, supplemented by later *Desk Sheets*. They are compilations from more extensive data collected and published by *Bradstreet's* and the *Construction News*. Reports are made to those journals by building inspectors or commissioners.

The twenty cities included in Babson's list are the following: New York City, Philadelphia, Pittsburgh, Cleveland, Cincinnati, Indianapolis, Chicago, Detroit, Memphis, Atlanta, New Orleans, St. Louis, St. Paul, Minneapolis, Kansas City (Kas. and Mo.), Milwaukee, Denver, Los Angeles, San Francisco, Seattle. The values of permits issued for this group are commonly 60 per cent or more of *Bradstreet's* values covering more than 100 cities. (Note the following sample: 1906, 79 per cent; 1908, 72 per cent; 1910, 67 per cent; 1912, 62 per cent; 1914, 60 per cent; 1916, 62 per cent.)

The series has been taken because it is apparently homogeneous.

SECULAR TREND. The linear trend, 1903-16 (Chart 6), has a uniform annual increment of \$986,000. The average of the monthly items is \$41,580,000. The fit of curve to the data was not very close, owing to the irregularity of the original series. There has been a pronounced falling off during the years 1917-18. The value of buildings erected by the federal government is not included in the reports.

SEASONAL VARIATION. The grouping of the link relatives indicates seasonal variation (Table A) in spite of their wide fluctuation (Table 6). There is a violent spring rise beginning in February and reaching a maximum of 135 in April. The drop from April to the following January (index of 70) is gradual and uninterrupted.

Exceptionally low link relatives occurred in August 1914 (68) and November 1907 (61); high relatives occurred in March 1903 (207), and 1904 (237).

CYCLES. The curve of moving averages does not show a distinct wave movement. This is especially true of the period beginning 1910. Indeed, even prior to 1910 the curve of averages varied widely in wave length. The maximum divergence from the linear trend was about 50 per cent of the corresponding ordinate of trend.

The cycles (Chart 106) range between $+2.5\sigma$ and -2.5σ except that a maximum of $+3.8\sigma$ is reached in 1916 and a minimum of -4.1σ is reached in 1918. The irregular fluctuations are so marked as to conceal the cyclical movement. ($\sigma = 20.4$)

(7) MONTHLY GROSS EARNINGS OF TEN LEADING RAILROADS

SOURCE AND NATURE OF DATA. This series has been transcribed from *Babson's Desk Sheet*. The ten railroads included are: Atchison, Topeka and Santa Fe; Atlantic Coast Line; Baltimore and Ohio; Central of New Jersey; Illinois Central; Missouri, Kansas and Texas; Pennsylvania; Chicago, Rock Island and Pacific; Southern Railway; and Union Pacific. The earnings of these roads appear from the following tests to embrace at least 26 per cent of the earnings of all railroads — 400 or more — covered by the *Commercial and Financial Chronicle*: 1904, 26 per cent; 1906, 26 per cent; 1908, 27 per cent; 1910, 26 per cent; 1912, 28 per cent; 1916, 28 per cent.

SECULAR TREND. The linear trend, 1903-16 (Chart 7), has a uniform annual increment of \$2,954,000. The average of the monthly items is \$60,000,000. The fit of the line to the data is very close, especially if allowance is made for the annual seasonal movement.

SEASONAL VARIATION. Frequency Table 7 for gross receipts of ten railroads reveals a systematic grouping of the link relatives. The months January to July show gross receipts less than the average for the year, and the months August to December show gross receipts greater than the average, the maximum index of 111 occurring in October. Allowing for the shortness of February, the minimum index (94) comes in January. Although the ten railroads cover every great section of the United States, the indices of seasonal variation should not be considered representative of the United States until the adequacy of the sample is demonstrated.

CYCLES. The curve of twelve months moving averages shows wave movements of small amplitude and varying length. The maximum divergence from the linear trend is about 10 per cent of the corresponding ordinate of trend. During the years 1910 and 1911 the line of averages is very nearly coincident with the line of secular trend.

The cycles (Chart 107) range from $+2.5\sigma$ to -2.5σ except that a maximum of $+3.5\sigma$ was reached in May 1917 (the series ends in June 1917). The irregular fluctuations are noticeable but the cyclical movement clearly dominates. ($\sigma = 6.07$)

(8) MONTHLY NUMBER OF SHARES SOLD ON THE NEW YORK STOCK EXCHANGE

SOURCE AND NATURE OF DATA. Monthly data are published in the *Commercial and Financial Chronicle*, and are later summarized for two-year periods in the *Financial Review*, in the section on "Clearings and Speculation." In order to secure revised figures, transcriptions for each year have been made from the *Financial Review* of the second year following, except for the years 1917-18. For such years figures have been taken from tables entitled "Volume of Business on the Stock Exchange," in the monthly "Bank and Quotation Section."

SECULAR TREND. The linear trend, 1903-16 (Chart 8), has a uniform annual increment of $-523,000$ shares. The average of the monthly items is 14,820,000 shares. The items of this series are quite irregular and hence diverge widely from the line of trend. The volume of sales has been nearly halved in the past fifteen years.

SEASONAL VARIATION. Frequency Table 8 shows that there is no consistent seasonal variation except, perhaps, in February as compared with January. The link relatives of all other months are widely scattered. If there is a seasonal movement, the period 1903-16 does not afford sufficient data to demonstrate it. Averages based on the items for the different months vary greatly, but these averages must not be taken as indices of seasonal variation.

CYCLES. The curve of twelve months moving averages shows a wave movement, quite irregular as to amplitude, length of wave, and smoothness of curve. The maximum divergence from the linear trend is about 90 per cent of the corresponding ordinate of trend.

The cycles (Chart 108) range from $+2.5\sigma$ to -1.5σ except that a maximum of $+4.2\sigma$ is reached in 1916. The irregular fluctuations are more marked than in any other series studied. The cyclical movement is concealed by the monthly data. ($\sigma = 49.6$)

(9) UNFILLED ORDERS OF THE UNITED STATES STEEL CORPORATION

SOURCE AND NATURE OF DATA. Monthly and annual reports of the United States Steel Corporation giving unfilled orders are published in the *Commercial and Financial Chronicle*. In the issues of the *Chronicle* for earlier years, the figures appear in the department devoted to general investment news, or under "Annual Reports." In the issues of recent years, however, they are published about the middle of each month under "Trade and Traffic Movements." For this study, transcription has been made from the last named summaries.

The tonnage of unfilled orders covering "all kinds of manufactured steel products"¹ has been published monthly since July 31, 1910, quarterly figures having been issued prior to that time. The figures are for the last day of the month. A significant change in basis, operative since September 30, 1907, is referred to in the following quotation from the Corporation's monthly report of November 10, 1910:

"The unfilled orders on hand October 31, 1910, aggregated 2,871,949 tons. This apparently is the smallest amount ever shown on the books, but the comparison is somewhat misleading because the basis has been changed to show only orders received from companies outside of our own interests. On the old basis the showing would be 3,583,990 tons as of October 31, 1910. The low figures heretofore shown were 3,027,000, as of September 30, 1904; but on the present basis they would have shown 2,434,736 tons."²

SECULAR TREND. The linear trend, 1908-14 (Chart 9), has a uniform annual increment of $+224,000$ tons. The average of the monthly items is 4,560,000 tons. The fit of the line to the data is not close, because of the short period covered and of the magnitude of the cyclical fluctuations. The divergence has been especially marked during the years 1916-18.

SEASONAL VARIATION. Monthly data are not available for a sufficiently long interval to measure the seasonal variation.

CYCLES. The curve of twelve months moving averages shows a decided cyclical movement, of large amplitude. Prior to the European war the maximum divergence from the linear trend was about 30 per cent

¹ United States Steel Corporation, *Sixth Annual Report*, p. 32.

² Quoted in the *Commercial and Financial Chronicle*, Nov. 12, 1910, p. 1333. It was there stated that "the present system of compiling orders has been in effect for approximately three years."

of the corresponding ordinate of trend. In 1917 a divergence of about 90 per cent was reached.

This series has a pronounced wave movement about its linear trend, but absence of comparable data for a sufficiently long period of time made the computation of cycles seem inadvisable.

(10) MONTHLY TONNAGE — LESS LAKE TRAFFIC — OF VESSELS ENTERED IN THE FOREIGN COMMERCE OF THE UNITED STATES

SOURCE AND NATURE OF DATA. The figures for this series have all been taken from the files of the *Monthly Summary of Foreign Commerce of the United States*, issued by the Department of Commerce. For the fifteen months from October 1912 to December 1913 inclusive, publication of the data was discontinued. So far as possible, figures for each month have been transcribed from the issue for the corresponding month of the following year, a precaution necessary for the reason that the current figures are always subject to correction. The number of corrections to be found by comparison of original and reprinted figures of the years since 1914 is relatively small, but the number increases steadily the further back one goes. The only uncorrected figures used in this study are those for the year 1917 and for the last three months of 1911. Since the form in which the tonnage statistics were presented changed several times during the course of the period covered, it was necessary to make varying combinations of the figures to secure a homogeneous series.

One of the main objects in studying tonnage entered was to determine if transoceanic traffic was subject to significant seasonal variations. It was necessary, therefore, to exclude the tonnage of lake traffic, which has a marked seasonal variation (for instance, from 120,000 net tons in February to 2,246,000 tons in August, 1916). In order to eliminate this variable element it was necessary to obtain total monthly figures and to subtract from them the figures for lake traffic. Previous to 1912, the figures for lake traffic were printed under the caption "Northern Border and Lake Ports." Beginning in January 1914, the form of classification was changed to one showing the foreign countries from which vessels entered. Under this new classification the lake traffic tonnage is included under the caption "Quebec, Ontario, etc." As the figures for tonnage entering from Quebec include some Atlantic traffic, the subtractions on account of "lake traffic" are too large, but not significantly so.

SECULAR TREND. The linear trend, 1900-17 (Chart 10), has a uniform annual increment of +70,300 net tons. The average of the monthly items is 2,483,000 net tons. Up to 1911 the fit of the line to the data is quite close, and it is reasonably close during the period 1914-18. There is a decided drop during the latter part of 1917, showing the effect of submarine attacks.

SEASONAL VARIATION. There appears to be no seasonal variation (Table 10) except that due to the vary-

ing lengths of the months. A very slight tendency toward a systematic excess from March to August is indicated.

Unusually low link relatives (Chart 10) occurred in February 1917 (78), May 1915 (88), August 1914 (83), and September 1917 (86). These were all war years. Other low items occurred in April 1911 (89), June 1901 (87), June 1905 (88), October 1902 (89), November 1901 (86), and December 1909 (92).

CYCLES. The curve of twelve months moving averages shows no decided or regular wave movement. There appears to be no cyclical movement for the series. The maximum divergence from the linear trend is about 10 per cent of the corresponding ordinate of trend.

The cycles were not computed for this series, because there was no cyclical movement of the items about their linear trend.

(11) BRADSTREET'S MONTHLY NUMBER OF BUSINESS FAILURES

SOURCE AND NATURE OF DATA. *Bradstreet's* includes in each issue, under the department "Measures of Movements," statistics of monthly business failures. These are conveniently summarized at intervals, summaries appearing usually in the department, "Leading Articles." For example, an early number in January of each year contains the data for the preceding year; or an issue appearing early in a month sometimes compares the failures of the preceding month with those of the corresponding month for a score of years past. The data used herein have been taken from these summaries.

"*Bradstreet's* definition of a failure is that it must involve some loss to creditors of individuals, firms or corporations engaged in ordinary commercial operations. Under this classification, failures of professional men, such as physicians, lawyers and actors, as well as stock brokers and real estate dealers, also old bankruptcies passing through the United States courts, have no place."¹

The statistics presented by *Bradstreet's* on this basis are presumably complete. Correspondents are employed who report all assignments directly from official records of bankruptcies and assignments. In compiling the figures, totals by states, banks and bankers, and for the whole, are taken. The methods of collection and of compilation, and the source and scope of the data have been uniform since 1881.

SECULAR TREND. The linear trend, 1903-16 (Chart 11), has a uniform annual increment of +54 failures. The average of the monthly items is 1076 failures. The fit of the line to the data is reasonably good, if allowance be made for the seasonal movement of the series which is very marked. The trend for 1890-1902 is downward, while that for 1903-16 is upward.

SEASONAL VARIATION. The seasonal variation in *Bradstreet's* number of commercial failures (Table 11) is simple, but pronounced. The indices are 98 or over

¹ *Bradstreet's*, Feb. 2, 1918, p. 77.

from October to March, inclusive, and 95 or under from April to September, inclusive, with the exceptional indices of 118 and 142 occurring in December and January, respectively.

Exceptionally low link relatives (Chart 11) occurred in January 1909 (100); March 1894, 1897 (71, 82); April 1916 (77); August 1895, 1894, 1898 (73, 76, 80); September 1893 (64); October 1896 (95); November 1893 (81); and December 1893, 1898, 1895 (84, 84, 87). Exceptionally high relatives occurred in January 1894, 1895, 1896 (164, 160, 197); February 1916 (89); April 1895, 1899 (117, 117); May 1893 (116); June 1893 (116); July 1893, 1895, 1894 (155, 138, 133); September 1894 (130); October 1895, 1898, 1893 (180, 151, 149); and December 1914, 1913 (140, 135). Both exceptionally low and exceptionally high link relatives occurred in the years 1893 to 1896. In 1893 unusually high relatives occurred from April to July followed by low relatives in September, November, and December. The clearing out of weak concerns made the number of failures lower than normal until the next regular accounting period, January 1894, when an exceptionally high relative appeared again. Although the seasonal variation of commercial failures is simple, the relation to business cycles is complex.

CYCLES. The curve of twelve months moving averages shows a wave movement quite irregular as to length and amplitude. The more striking features are the long trough (1909-13) and the sudden rise during the period immediately following the outbreak of the European war. The maximum divergence from the linear trend is about 25 per cent of the corresponding ordinate of trend (in 1915).

In the pre-war period the cycles (Chart 111) range from $+2.5\sigma$ to -2.0σ . During the war the range is markedly wider, reaching a maximum of $+3.5\sigma$ in 1914, and a minimum of -4.5σ in 1918. Though the irregular fluctuations are marked, the cyclical movement is clearly discernible. ($\sigma = 13.55$)

(12) MONTHLY RATE OF INTEREST ON TEN AMERICAN RAILROAD BONDS

SOURCE AND NATURE OF DATA. The items for 1890-1915 have been transcribed from the following sources: for the period 1890-1911, W. C. Mitchell's *Business Cycles*, pp. 150-156; for the period 1912-15, articles by Professor Mitchell in the *Journal of Political Economy*, 21, p. 512; 24, p. 146. Mitchell's series, which he has not carried beyond 1915, has been extended through 1918 by the *Review of Economic Statistics*. The data utilized were taken from the sources used by Mitchell. The sources for 1916-18 were: for the period 1916-17, the *Financial Review*, 1918, pp. 166-186 incl.; for 1918, the monthly "Bank and Quotation Section" of the *Commercial and Financial Chronicle*.

Since bonds are quoted in dollars and eighths per \$100 par value, the averages are reliable to three digits.

The ten bonds used by Mitchell for the period 1890-1912 inclusive were:¹

RAILROAD	BONDS
Chicago and Eastern Illinois.	General consolidated and first mortgage.
Missouri, Kansas and Texas.	First mortgage.
Wabash.	First mortgage.
Chesapeake and Ohio.	First consolidated mortgage.
Chicago, St. Paul, Minneapolis and Omaha.	Consolidated mortgage.
Chicago, Burlington, and Quincy.	Nebraska extension bonds, secured by deposit of first mortgage bonds of Nebraska branch roads.
Central Railroad of New Jersey.	General mortgage.
Chicago, Milwaukee and St. Paul.	General mortgage, "Series A."
New York, Chicago and St. Louis.	First mortgage.
West Shore Railroad.	First mortgage, guaranteed by the New York Central.

The actual average rates of interest by months on these bonds were computed as follows:

"The lowest and highest prices of these bonds in each month of 1890-1911 were obtained from the *Financial Review*. The means between these extreme quotations were struck, after accrued interest, as of the middle of the month, had been deducted. Their net yields were computed for each month from these mean quotations by the aid of bond tables."²

"When a bond lacked a quotation for some month, its net yield was interpolated by supposing that this yield varied from the net yield of the preceding or following month in the same proportion that the average net yield of the remaining bonds varied."³

In 1913 three railroads on the list were found to have fallen into financial difficulties. In order to continue the series giving the yield on "high class" investments, Mitchell made a substitution beginning January 1913, as follows:

Discarded Bond	Substituted Bond	Yield Jan. 1913	Multiplier used
Chicago and Eastern Illinois general consolidated and first mortgage.	Atchison, Topeka and Santa Fe general gold 4's, due 1995.	4.11 %	1.102
Missouri, Kansas and Texas first mortgage.	Pennsylvania Railroad consolidated gold 4's, due 1948.	3.90 %	1.087
Wabash first mortgage.	Reading general gold 4's, due 1997.	4.12 %	1.1163

To maintain comparability, the yield of the bonds introduced was multiplied by factors to make their yield "equal to the yield on the three discarded series, before the credit of the latter had been seriously impaired."⁴

In computing the rates for 1916-18 inclusive, the method described above has been followed throughout. Since 1909, however, it has been unnecessary to deduct "accrued interest as of the middle of the month," because "Since Jan. 1, 1909, the Exchange method of quoting bonds has been changed, and prices are now

¹ Mitchell's *Business Cycles*, p. 142.

² *Ibid.*, p. 141.

³ *Ibid.*, p. 141, footnote.

⁴ Mitchell, "American Security Prices and Interest Rates," *Journal of Political Economy*, 24, p. 144.

all — ‘and interest’ — except for income and defaulted bonds.”¹

SECULAR TREND. The linear trend, 1903–16 (Chart 12), has a uniform annual increment of $+.05$ per cent. The average of the monthly items is 4.17 per cent. The fit of the line to the data is close except during the fall of 1907 and during the years 1917–18. The trend for the period 1890–1902 is strongly downward, while that for 1903–16 is strongly upward.

SEASONAL VARIATION. Table 12 reveals no systematic seasonal variation except, perhaps, a slight tendency toward a summer and autumn rise. Exceptionally low link relatives (Chart 12) occurred in January 1908 and 1891 (96.0, 97.4); February 1914 (98.0); May 1898, 1895 (97.5, 98.0); June 1898, 1895 (98.1, 98.2); July 1904 (98.7); August 1908 (98.6); September 1893 (96.5); October 1915 (97.9); November 1896 (96.8) and December 1907 (98.0). Exceptionally high relatives occurred in February 1895 (101.3); March 1907, 1898 (102.2, 102.9); April 1898 (102.3); May 1913 (102.3); July 1893, 1896 (both 103.1); August 1893, 1896 (102.9, 103.5); October 1907 (102.3); November 1907, 1914 (103.7, 103.8); and December 1890 (102.0).

CYCLES. The curve of twelve months moving averages shows small wave movements which are smooth, but quite irregular as to length and amplitude. There is a sharp upward rise during 1917–18, and the crest has apparently not yet been reached. Prior to 1917 the maximum divergence from the linear trend is about 5 per cent of the corresponding ordinate of trend.

The cycles (Chart 112) range from $+2.00$ to -1.50 , except that in 1907 a maximum of $+4.00$ is reached, and in 1917, $+3.40$. The irregular fluctuations are comparatively small. ($\sigma = 2.82$)

(13) MONTHLY RATE OF INTEREST ON FOUR-TO-SIX MONTHS COMMERCIAL PAPER

SOURCE AND NATURE OF DATA. The items for 1890–1915 have been transcribed from the following sources: for the period 1890 to 1911, Mitchell's *Business Cycles*, pp. 150–156; for the period 1912–15, articles by Professor Mitchell in the *Journal of Political Economy*, 21, p. 512; 24, p. 146. Mitchell's series, which he has not carried beyond 1915, has been extended through 1918 by the *Review of Economic Statistics*. The data utilized were taken from the sources used by Mitchell. The sources for 1916–18 were: for the period 1916–17, the *Financial Review*, 1918, pp. 76–77; for 1918, the monthly “Bank and Quotation Section” of the *Commercial and Financial Chronicle*, under the caption “Rates for Money in New York Weekly.”

The quotations taken are the rates for good single-name commercial paper running 4 to 6 months.

The original weekly quotations upon which these monthly averages are based may be found (with numerous other series of interest rates) for the period 1890–1909 in *Statistics for the United States*, 1867–90 (Report of National Monetary Commission), pp. 119–138.

Mitchell states that: “In reducing the weekly rates given in the source to monthly averages, each week was placed in that month in which fell the majority of its days. Both the high and low figures were included in making the averages.”²

For 1916–18, the method followed has been identical with Mitchell's.

SECULAR TREND. The linear trend, 1903–16 (Chart 13), has a uniform annual increment of $-.102$ per cent. The average of the monthly items is 5.32 per cent. The fit of the line to the data is reasonably close, except during the last few months of 1914. The trend during 1890–1902 does not differ markedly from the trend for 1903–16.

SEASONAL VARIATION. A consistent seasonal variation in the link relatives of Table 13 is apparent. In this series the varying lengths of the months do not affect the items. Rates on four-to-six months commercial paper drop steadily, except for March, from December to June (minimum index, 93). Then follows a rapid rise to the maximum of 108 in September and October, and a slight drop to 106 in November and December.

Exceptionally low items occurred in January 1914 (81); February 1896 (82); April 1904 (86); May 1895, 1898, 1908 (78, 80, 81); June 1898 (82); October 1893 (76); November 1896, 1893 (72, 75); and December 1914, 1896 (75, 82). Exceptionally high items occurred in January 1896 (131); February 1895 (115); March 1898 (134), April 1898 (124); May 1893 (136); June 1893 (117); July 1892 (117); August 1895, 1896, 1914 (121, 130, 139); November 1890 (122), and December 1895 (124).

CYCLES. The curve of twelve months moving averages shows decided wave movements, which are, however, somewhat irregular as to length and amplitude. The maximum divergence from the line of trend is about 25 per cent of the corresponding ordinate of trend (1918).

The cycles (Chart 113) range from $+3.00$ to -2.00 . Except for the period following the beginning of the Great War in 1914, the irregular fluctuations are not marked. The cyclical movement stands out clearly. ($\sigma = 16.46$)

(14) MONTHLY RATE OF INTEREST ON SIXTY-TO-NINETY DAY COMMERCIAL PAPER IN NEW YORK

SOURCE AND NATURE OF DATA. The items for 1890–1915 have been transcribed from the following sources: for the period 1890–1911, Mitchell's *Business Cycles*, pp. 150–156; for the period 1912–15, articles by Professor Mitchell in the *Journal of Political Economy*, 21, p. 512; 24, p. 146. Mitchell's series, which he has not carried beyond 1915, has been extended through 1918 by the *Review of Economic Statistics*. The data utilized were from the sources used by Mitchell. The sources for 1916–18 were: for the period 1916–17, the *Financial Review*, 1918, pp. 76, 77; for 1918, the

¹ *Commercial and Financial Chronicle*, Jan. 30, 1909, p. 280.

² Mitchell's *Business Cycles*, p. 149.

monthly "Bank and Quotation Section" of the *Commercial and Financial Chronicle*, under the caption, "Rates for Money in New York Weekly."

The quotations taken are the rates for choice double-name commercial paper running 60 to 90 days.

The original weekly quotations upon which these monthly averages are based may be found (with numerous other series of interest rates) for the period 1890-1909 in *Statistics for the United States*, 1867-90 (Report of National Monetary Commission), pp. 119-138.

In making his computations for the actual monthly rate of interest on this paper, Mitchell followed the same procedure described in the case of the four-to-six months commercial paper. The same method has been used for the years 1916-18.

SECULAR TREND. The linear trend, 1903-16 (Chart 14), has a uniform annual increment of $-.089$ per cent. The average of the monthly items is $+4.68$ per cent. The data are widely scattered about the linear trend. The slope of the line fitted for 1903-16 is downward; the slope of the line fitted for 1890-1902 is also negative, but the downward movement is not so decided as in 1903-16.

SEASONAL VARIATION. There is a consistent seasonal variation in the rate on sixty-to-ninety day commercial paper (Table 14). Starting with an index of 99 in January, there is a fall to 92 in February, succeeded by a rise culminating in March (96), followed by a gradual fall to the minimum of 89 in June, and a violent rise to 110, which level is maintained from September to December. This movement is similar to that for the rate on four-to-six months commercial paper, but the former is more pronounced. Comparison of the two movements is presented graphically in Chart K.

Exceptionally low link relatives (Chart 14) occurred in February 1908 (77); April 1908 (78); May 1895, 1898 (69, 80); June 1898 (70); July 1915 (89); September 1893 (86); October 1893, 1898, 1894 (72, 82, 83); November 1896, 1893 (61, 75); and December 1896, 1914, 1893 (71, 79, 82). Exceptionally high link relatives occurred in January 1896 (131); February 1895 (122); March 1899, 1893, 1898 (128, 140, 150); April 1898 (123); May 1893 (116); June 1893 (132); August 1914, 1896 (144, 151); September 1892 (119); and November 1890 (139). Erratic variations, both maxima and minima, occurred during the war years of 1898 and 1914, as well as during the years of financial disturbance, 1890, 1893, and 1896. Apparently the Morgan syndicate was effective in preventing a violent rise in 1907; nevertheless a violent fall occurred in 1908. The greatest dispersion occurs in the autumn and winter.

CYCLES. The curve of twelve months moving averages shows distinct wave movements. The wave movements vary markedly, however, in their length and amplitude. The maximum divergence from the linear trend is about 45 per cent of the corresponding ordinate of trend.

The cycles (Chart 114) range from $+2.6\sigma$ to -1.8σ , except for the rise to 3.1σ in 1918. The irregular fluctuations

are marked in the war years, 1914-18. In the period prior to 1914, however, the cyclical movement clearly dominates. ($\sigma = 19.66$)

(15) MONTHLY RATE OF INTEREST ON CALL LOANS AT THE NEW YORK STOCK EXCHANGE

SOURCE AND NATURE OF DATA. The items for 1890-1915 have been transcribed from the following sources: for the period 1890-1911, Mitchell's *Business Cycles*, pp. 150-156; for the period 1912-15, articles by Professor Mitchell in the *Journal of Political Economy*, 21, p. 512; 24, p. 146. Mitchell's series, which he has not carried beyond 1915, has been extended through 1918 by the *Review of Economic Statistics*. The data utilized were taken from the sources used by Mitchell. The sources for 1916-18 were: for the period 1916-17, the *Financial Review*, 1918, pp. 76, 77; for 1918, the monthly "Bank and Quotation Section" of the *Commercial and Financial Chronicle*, under the caption "Rates for Money in New York Weekly." Mitchell's original figures were taken from the *Financial Review*.

The original weekly quotations upon which these monthly averages are based may be found (with numerous other series of interest rates) for the period 1890-1909 in *Statistics for the United States*, 1867-90 (Report of National Monetary Commission), pp. 119-138.

For 1916-18 inclusive, following the method employed by Mitchell for the years 1890-1915, "The average interest upon call loans is computed from the average stock exchange rates by weeks."¹ "In making this computation, each week was assigned to that month in which the majority of its days fell."² This method has been continued for the years 1916-18.

SECULAR TREND. There is no evidence of any long-time tendency either upward or downward during 1890-1918 (Chart 15). Hence, no straight line has been fitted to the data. The short-time fluctuations dominate.

SEASONAL VARIATION. Stock exchange call rates show a marked seasonal variation (Table 15). Starting with an index of 83 in February, there is a spring rise to a maximum of 91 in April, followed by a gradual fall to the summer level of 80, maintained from June to August. A violent continuous rise from 104 in September culminates in the maximum of 150 reached in December. From this maximum of 150 there is a precipitate drop in January and February.

Exceptionally low link relatives (Chart 15) occurred in February 1908 (38); March 1909 (82); April 1907 (37); May 1906 (44); June 1902 (51); September 1890, 1893 (58, 68); October 1906, 1898, 1893 (55, 60, 63); November 1896, 1907, 1902 (56, 58, 64); and December 1896, 1914 (31, 62). Exceptionally high relatives occurred in January 1899 (113), February 1909 (124); March 1893, 1903 (273, 208); April 1906, 1901 (195, 184); May 1901 (160); June 1893 (247); July 1899 (170); August 1890, 1914, 1896 (253, 236, 226); September 1902 (286); October 1907, 1900 (525, 222);

¹ Mitchell's *Business Cycles*, p. 175.

² *Ibid.*, p. 175, footnote.

November 1903 (193); and December 1895, 1905 (231, 214). Erratic call rates occurred, of course, in times of speculation and great business activity, as well as in times of crises.

CYCLES. The curve of twelve months totals shows a highly irregular movement.

The cycles were not computed for this series, because there was no cyclical movement of the items about their linear trend.

Mr. J. C. Stamp has recently endorsed the method of measuring secular trend used in this paper. In an article on "The Effect of Trade Fluctuations upon Profits" in the July number of the *Journal of the Royal Statistical Society* (81, p. 569) he says: "It is usually

found that a linear trend can properly be 'fitted' to these series of statistics. This trend, fitted by the method of least squares, gives an excellent point from which to measure deviations, and in my judgment is superior to the moving average in almost all respects."

In the next number of the REVIEW OF ECONOMIC STATISTICS the current data for series just discussed will be analyzed. In addition, six or eight other series will be treated according to the statistical method here applied. Monthly reserves, loans, and deposits of New York clearing house banks for the period beginning in 1879, sterling exchange rates since 1889, and the average price of railroad and of industrial stocks since 1897 are some of the series already collected. Non-financial series will also be included.

WARREN M. PERSONS.